

## **Optimal Capacitor Placement to LV Distribution Network: A Simple Design Approach using Excel Sheet**

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Shunt capacitors are usually installed in LV distribution networks to reduce power losses and system voltage drops. Recently, the Ceylon Electricity Board installed LV shunt capacitors in some of their selected 11/0.4 kV distribution substations in the Kandy region. This paper proposes a simple design approach in determining the optimal size and the location of such capacitors by using Microsoft Excel spreadsheet software. Two distribution substations namely Siyambalagastenna (SIY) and Mavilmada (MAV) were selected in Kandy city area. The SIY substation was selected for preliminary studies on capacitor placement whereas the MAV substation was used for investigating the proposed design approach.

The daily load patterns were obtained on both substations by using a Fluke 1735 data logger. The active, reactive, and apparent powers, power factor, voltages and current data were recorded for every minute continuously for 24 hours, with and without capacitors, at the transformer end. In the preliminary studies at SIY substation, the measured power values were compared with calculated values and it was found that the error was within 5% during peak hours and 10% during off-peak hours. In the design approach, the distribution network was built-up in Excel spreadsheets by line parameters (line resistance, reactance and distance) and customer loads connected to each pole. The customer loads were obtained first by calculating the average power consumption (from electricity bills during 6 month period) and then by normalising them by measured power at the transformer end. The pole voltages and the power losses were calculated using cumulative power in the distribution network. The line voltage drops were checked by random voltage measurements at the feeder end of the MAV distribution network. The optimal size and capacitor placement were determined while checking reduction of power losses and improvements of voltage drops. It was found that the proposed method provides useful information in designing capacitor size and location.